Experimental Investigation of Combustion, Emissions and Thermal Balance of Secondary butyl alcohol-gasoline Blends in a Spark Ignition Engine

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ABSTRACT

An experimental investigation of butanol as an alternative fuel was conducted. A four-cylinder, fourstroke gasoline engine was used to investigate the engine combustion emissions and thermal balance characteristics using 2-butanol–gasoline blended fuels at 50% throttle wide open. In this experimental study, the gasoline engine was tested at 2-butanol–gasoline percentage volume ratios of 5:95 (GBu5), 10:90 (GBu10) and 15:85 (GBu15) of gasoline to butanol, respectively. Combustion analysis results showed that 2-butanol–gasoline blends have a lower in-cylinder pressure, rate of pressure rise and rate of heat release. However, as the 2-butanol addition increases in the blended fuels, increasing trends of incylinder pressure, rate of pressure rise and rate of heat release are observed, but it is still lower than G100 fuels. Moreover, even 5%, 10% and 15% additions of 2-butanol in the gasoline fuels improve the COV of IMEP by 3.7, 3.46 and 3.26, respectively, which indicates that the presence of 2-butanol stabilises the combustion process. Comparative analysis of the experimental results by exhaust emissions produced an average of 7.1%, 13.7%, and 19.8% lower NOx for GBu5, GBu10 and GBu15, respectively, over the speed range of 1000–4000 RPM. Other emission contents indicate lower CO and HC but higher CO2 from 2500 to 4000 RPM for the blended fuels with regard to G100. The thermal balance analysis mainly exhibits an improvement in effective power, cooling energy and exhaust energy by average differences of 3.3%, 0.8% and 2.3% for GBu15 compared with G100.

KEYWORDS: Emissions; Combustion; Thermal balance; 2-Butanol

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